$$CaX(A^2\Pi_{1/2}) + Ar(He) \xrightarrow{k_7} CaX(X^2\Sigma^+) + Ar(He),$$

$$CaX(A^2\Pi_{3/2}) \xrightarrow{k_3} CaX(X^2\Sigma^+) + h\nu_3,$$

$$CaX(A^2\Pi_{1/2}) \xrightarrow{k_4} CaX(X^2\Sigma^+) + h\nu_4.$$

The time-dependent population equations of $A^2\Pi_{3/2}$ and $A^2\Pi_{1/2}$ are then written out and solved to show that the steady-state assumption should be approximately valid if only appropriate parameters have been chosen for boxcar operations.

Under steady-state condition, the ratio of fluorescence intensities of $A^2\Pi_{3/2} \rightarrow X^2\Sigma^+$ and $A^2\Pi_{1/2} \rightarrow X^2\Sigma^+$ can be used to calculate the rate constant k_5 by the equation

$$\frac{I(A^2\Pi_{3/2} - X^2\Sigma^+)}{I(A^2\Pi_{1/2} - X^2\Sigma^+)} = \frac{k_3}{k_5} \cdot \left(\frac{k_7}{k_5} + \frac{k_5}{k_4}\right) + \frac{k_3}{k_5} \cdot \frac{1}{P_{Ar}},$$

where k_3 is taken from the literature.

The cross sections obtained for $CaX(A^2\Pi_{3/2}) + Ar \rightleftharpoons CaX(A^2\Pi_{1/2}) + Ar + \Delta E$ processes are shown in the following table:

	CaF	CaCl	CaBr	CaI
$\sigma_1(A^2\Pi_{3/2} \rightarrow A^2\Pi_{1/2})$ (Å^2)	23	17	13	8.4
$\sigma_2(A^2\Pi_{1/2} \rightarrow A^2\Pi_{3/2})$ (Å^2)	20	14	8.8	7.8
ΔE (cm^{-1})	75	69.5	63.3	60

The cross sections for $CaX(A^2\Pi_{3/2}) + He \rightarrow CaX(A^2\Pi_{1/2}) + He$ are almost the same (8–11 Å^2) for all the halogens.

The time- and wavelength-resolved LIF for the systems mentioned above are now under study. (Poster paper)

WII12. High-Spatial-Resolution Spectroscopic Technique for Measuring Hyperfine Structure of Atoms and Molecules, Yu-zhu Wang, *Shanghai Institute of Optics and Fine Mechanics, Academia Sinica, P.O. Box 8211, Shanghai, China.*

A high-spatial-resolution spectroscopic technique (HSRST) is reported. The HSRST can be used for measuring hyperfine splitting of atoms and molecules. The principle of the HSRST is based on the Doppler effect, by which the frequency spectra of the atoms and molecules are translated to a spatial intensity spectra of fluorescence. Measuring the spatial intensity distribution, we can obtain the hyperfine splitting of atoms and molecules. A divergent atomic beam and a divergent laser beam interact with each other in a space; theoretical calculation shows that fluorescence loci of excited atoms and molecules are a series of arcs, and the number of the arcs indicates the number of hyperfine splittings. If the laser frequency is so tuned that its value is just between two transition frequencies, there are two bands of fluorescence separated by a dark region, in which only atoms with very high speed can satisfy the resonant condition. The dark region really exists, because the atoms that have very high speed are very few, and the atoms with infinite speed do not exist. If the linewidth of laser radiation is less than two hyperfine splittings, we can always separate the two hyperfine splittings. A relation of hyperfine splitting ΔF and distance ΔS between the two fluorescence bands is expressed as

$$\Delta F = \frac{2\Delta S \cdot v_\alpha}{\lambda(\Delta S^2 + L^2)^{1/2}},$$

where v_α is the probable velocity of atoms, λ is the laser wavelength, and L is a distance between the two sources of the atomic beam and the laser beam. Measuring ΔS, ΔF can be determined. One advantage of this technique is that there is no need to measure the frequency of the laser beam. In addition, spectral resolution of this technique is very high, its limitation being the natural linewidth of the atoms and molecules. (Poster paper)

[1] Wang Yu-zhu *et al.*, Digest of 83 ICL (Suppl.) Guangzhou, China, p. 32 (1983).
[2] Zhou Ru-fang *et al.*, to be published in Acta Opt. Sinica.

WII13. Nonlinear Interface Behavior between Glass and Liquid Crystal, J. A. Martin-Pereda, *E.T.S. Ing. Telecomunicacion, Ciudad Universitaria, Madrid-3, Spain.*

As has been shown in the literature,[1] an interface between two dielectric materials, one of which has an intensity-dependent refractive index is capable of exhibiting a wide range of complex and potentially useful optical phenomena. The results obtained when the nonlinear material employed is a nematic liquid crystal, namely, *N*(*p*-methoxy benzylidene)-*p*-*n*-butylaniline (MBBA), are reported.

The experimental setup was similar to the one employed by Smith *et al.*[1] for their study with CS_2. The input was generated by an Ar^+ laser beam. The cell was made from optically contacted slabs of glass allowing the observation of both reflected and transmitted light beams without obstruction near the interface. The liquid crystal had an homeotropic alignment, and it was working at room temperature. A photodiode was employed to monitor both the incident light and the reflected or transmitted beams.

The variation of refractive index in the liquid crystal is due to molecular realignment because of beam polarization. Several papers[2] have studied this effect showing, in transmission, the appearance of multiple-ring diffraction patterns, for a homeotropic molecular alignment and normal incidence of the laser beam onto the cell. In our case, the laser-beam polarization is parallel to the surface.

From the experiments, a variation on the reflected intensity has been obtained when a certain threshold has been achieved. The system has shown hysteresis and optical bistability. The reflectivity departs from unity at some value of intensity and returns to unity at a lower value. Higher values of intensity give rise to a molecular reorientation similar to the one reported previously for normal incidence. Moreover, some instabilities have appeared at higher laser intensities. It is still not clear how the transient field is redistributed in the region of the interface. A theoretical model for this case is difficult to present because of the characteristics of the liquid-crystal material. Switching times are much larger than that reported for CS_2 glass because, in this case, a molecular reorientation is needed. Obtained times are on the order of milliseconds. A functional dependence of the threshold intensity on the ratio of the incident angle to critical angle is given. Results are given for other molecular configurations and beam polarizations. (Poster paper)

[1] P. W. Smith, W. J. Tomlinson, P. J. Maloney, and J. P. Hermann, IEEE Trans. Electron Devices **DE-17,** 340 (1981).
[2] S. D. Durbin, S. M. Arakelian, and Y. R. Shen, Phys. Rev. Lett. **47,** 1411 (1981).

WII14. Infrared Multiple-Photon Dissociation of Chloroform-d, María Laura Azcárate, *Centro de Investigaciones en Láseres y Aplicaciones (Instituto de Investigaciones Cientificas y Técnicas de las Fuerzas Armadas-Consejo Nacional de Investigaciones Cientificas y Técnicas, Zufriategui y Varela, 1306 Villa Martelli, Argentina.*

Infrared multiple-photon dissociation of many fluorinated and chlorinated deuterium-containing hydrocarbons has been thoroughly investigated with a view to attaining high isotopic enrichment. Among these molecules little attention has been paid to chloroform, although it has a high rate of H/D exchange in base-catalyzed aqueous solutions, probably because the $CDCl_3$ ν_4 mode (913 cm^{-1}) is resonant with the low gain 10.96-μm $P(50)$ line of the CO_2 laser.

A homemade CO_2 TEA-type laser was used to study the multiple-photon dissociation of neat $CDCl_3$ and in equimolar $CHCl_3/CDCl_3$ mixtures. The output at the $P(20)$ 10.6-μm emission line was 1.5 J/pulse with a pulse duration of 250 nsec.

Figure WII14-1 shows the fraction of molecules dissociated as a function of laser excitation frequency. The dissociation maximum is red shifted $\geq$6 cm^{-1} as compared with the linear absorption maximum. This effect is in accordance with that observed in $CTCl_3$ (Ref. 1) and CDF_3 (Ref. 2) and is related to the large anharmonicity of the ν_4 mode.